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Word did not find any entries for your table of contents.**TITLE:** Is the NHS 'Heart Age Test' Too Much Medicine?

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INTRODUCTION

The NHS 'Heart Age Test' has expanded CVD risk assessment in the UK to include younger people. Public Health England's 'Healthy Heart' campaign, launched in September 2018, encourages all adults aged 30+ years to do the test (see Figure 1), stating: "*Having a heart age older than your chronological age means that you are at a higher risk of having a heart attack or stroke*." But does older heart age really mean high risk? The calculator will give you an older age if at least one CVD risk factor is higher than the level set as 'optimal'; but this does not necessarily mean you are at high risk of a CVD event in the next 10 years, as shown by the examples in Figure 1. Is there evidence to support PHE's promotion of the heart age test? To find out, we evaluated the 'Heart Age Test' according to Public Health England's own National Screening Committee criteria. This analysis suggests heart age is not a good screening test.

Figure 1. NHS 'Heart Age Test' [INSERT FIGURE 1 HERE]

Caption: Heart Age Test results for a 35 year-old woman at low risk of CVD (Case 1,Table 1).

1. The condition should be an important health problem as judged by its frequency and/or severity. CVD is an important health problem. The rate of death from CVD has declined throughout the UK in the last 3 decades,(1) but CVD remains the leading cause of death in men and second leading cause of death in women, with around 160,000 people in the UK dying from CVD every year.

2. There should be a simple, safe, precise and validated screening test. Though the 'Heart Age Test' calculator is simple and physically safe to use, it is not precise or validated. Heart age is estimated from the lifetime risk of CVD, relative to people of the same age, gender and ethnicity who have 'optimal' risk factor levels (e.g. non-smoker, systolic blood pressure <120 mm Hg).(2) The authors of the last update of the NICE guidelines on CVD risk assessment in 2014 found insufficient evidence to recommend lifetime risk as a validated screening test. There is even less evidence for indirect measures of lifetime risk, such as heart age.

3. The distribution of test values in the target population should be known and a suitable cut-off level defined and agreed. The 'Heart Age Test' targets everyone aged 30+ years, and is disproportionately used by younger people <40 years.(2) In contrast, formal CVD risk assessment as part of NHS Health Checks targets people ≥40 years. According to Public Health England, of two million 'Heart Age Test' users the majority (78%) had older heart age. All are prompted to visit a GP and described as having 'increased risk of heart disease', but there has been no assessment on the suitability of [heart age – chronological age] >0 as a cut-off level to prompt further testing.

4. The test, from sample collection to delivery of results, should be acceptable to the target population. The acceptability of heart age depends on whether it matches users' expectations. A 'think aloud' study found that older heart age was confronting and discredited by users if it did not match prior risk perception; while younger heart age was viewed as positive but unrealistic.(3) A randomised trial confirmed that heart age was perceived as less credible and

elicits more negative emotions compared to absolute CVD risk.(4) Further acceptability issues are highlighted by public responses (Supplement 1).

5. There should be an agreed policy on the further diagnostic investigation of individuals with a positive test result and on the choices available to those individuals. There is no agreed policy on further investigation of individuals with older heart age results (i.e. 78% of users). It prompts people to have an NHS Health Check, which is recommended for those over 40 and which itself is controversial. A Cochrane review found no evidence that these checks are beneficial, and they may even cause harm through the diagnosis and treatment of conditions unlikely to cause symptoms or death (i.e. overdiagnosis and overtreatment).(5) Encouraging large numbers of asymptomatic young people to have their blood pressure and cholesterol measured is not an agreed policy with the RCGP or the UK National Screening Committee.

6. There should be agreed evidence-based policies covering which individuals should be offered interventions and the appropriate intervention to be offered. Convincing patients with CVD risk factors to change their lifestyle is important at any age, and heart age could be used for this.(6) An RCT found that online assessment of heart age can improve risk factor management compared to verbal counselling about absolute risk.(7) However, direct experimental comparisons between heart age and absolute risk have found no effect on lifestyle intentions or behaviour.(4) Where heart age has motivated lifestyle change, this has been within a clinical context. This is quite different to a pre-consultation screening test, where existing lifestyle and circumstances are not taken into account, resulting in implausible heart age estimates that discredit the results (e.g. older heart age in very fit people, or younger heart age in

obese people).(3) Medication guidelines recommend assessing the absolute risk of a CVD event and prioritising treatment to those at highest risk who are most likely to benefit.(8) Absolute risk is preferred for treatment decisions, rather than single risk factors such as blood pressure (9) or cholesterol. Heart age is an ill-defined measure of risk, relative to others of the same age, gender and ethnicity with optimal risk factor levels.(3,10) As it is not a measure of absolute risk, it is not helpful for medication decisions.(4,10)

7. There should be evidence from high quality randomised controlled trials that screening is effective in reducing mortality or morbidity. There is evidence for several interventions that might be prompted through heart age screening, including smoking advice and lowering blood pressure/cholesterol. However, the Cochrane review of health checks shows that promoting these in a non-targeted way has no impact on actual CVD,(5) possibly because it attracts people at lower, rather than higher, risk. Since predominantly younger people use the 'Heart Age Test',(2) it may exacerbate the problem of low risk people attending health checks. There is no trial evidence that using heart age to screen for CVD risk or prompt formal CVD assessment reduces mortality or morbidity.

8. The benefit gained by individuals from the screening programme should outweigh any harms. The 'Heart Age Test' has no direct evidence of benefit, and there is potential for harm. Heart age results may lead high risk people to disregard relevant risk information if they don't believe the results, and cause low risk people to worry and seek unnecessary tests.(3,4) Other potential harms include negative psychological and behavioural effects of disease labelling,

physical harms and side effects of unnecessary tests or treatment for CVD, hassles and cost of unnecessary tests and treatments, wasted resources and opportunity costs to the health system. These harms, which contribute to overmedicalisation of society in general,(11) should not be underestimated.

9. The opportunity cost of the screening programme (including testing, diagnosis and treatment, administration, training and quality assurance) should be economically balanced in relation to expenditure on medical care as a whole. The 'Heart Age Test' tells anyone over 30 to make an appointment with their GP, nurse or pharmacist to have their cholesterol level or blood pressure measured if this is unknown. This may add to GPs' already overburdened workload, increase waiting times and detract attention from necessary high value care/ treatments for patients who are unwell.

10. Evidence-based information, explaining the purpose and potential consequences of screening, investigation and preventative intervention or treatment, should be made available to potential participants to assist them in making an informed choice. There is very little published information explaining what exactly heart age represents to enable an informed choice on whether or not to use it. As a GP wrote recently in The BMJ Opinion:

> *"I've looked at the supporting documents and can't find any answers. Perhaps they're there if you dig deep enough through the JBS3 website (which the tool points you towards), but that's not the point. If I can't find the answer after 20 minutes of looking, who else is going to bother? The public deserve to know how accurate these estimates*

are. Presenting uncertainty as fact is not what the public, or our patients, want or need." *(BMJ Blogs, 2018 Sept 12)*

The 'Heart Age Test' provides no information about who should use it, recommends cholesterol and blood pressure testing for everyone who does not enter values for these, and provides no information about the potential benefits, harms and costs of having these additional tests done and of taking any medication which might subsequently be offered.(10) It is therefore not possible to make an informed choice about using it.(12) Furthermore, the 'Heart Age Test' may confuse people when heart age and absolute risk are contradicting (e.g. low risk but heart age higher than own age), and convey conflicting messages about the person's risk and the need for medication.(3)

CONCLUSION

The 'Heart Age Test' is effectively a screening test that expands CVD risk assessment to include younger people without proper consultation or informed consent. It encourages almost 80% of – mostly young – users to see their GP for further medical interventions. Apart from being a test for an important condition (CVD), the 'Heart Age Test' meets none of the National Health England's own assessment criteria for a potentially useful screening test. As stated in a recent article about the de-adoption of ineffective clinical practices:

"*We need to take a more cautious approach to technology adoption, and learn from mistakes of early adoption of health care technologies based on little or low-quality clinical evidence. This way we can prevent the need to 'break up' with the practice when the high-quality evidence shows that it is ineffective*." (New York Times, 2018 Sept 11)

The NHS might do well to take this advice before adopting and promoting online technologies such as heart age calculators. The results of heart age calculators should be limited to lifestyle advice, ideally within the setting of the clinical consultation, to avoid inadvertent population screening for CVD using an unvalidated screening test.

AUTHOR CONTRIBUTIONS

KB and JJ are the guarantors of the article and drafted the manuscript with CB, based on her PhD investigating CVD risk communication, including heart age. All authors contributed to discussion and revision of the paper. CB, SM, KM and JJ are psychology academics with expertise in shared decision making and risk communication. KB and LI are clinical epidemiologists with expertise in test evaluation and CVD risk models. PG and JD are academic GPs with expertise in evidence-based practice and clinical CVD guidelines.

CONFLICTS OF INTEREST

We declare that we have no conflicts of interest to report.

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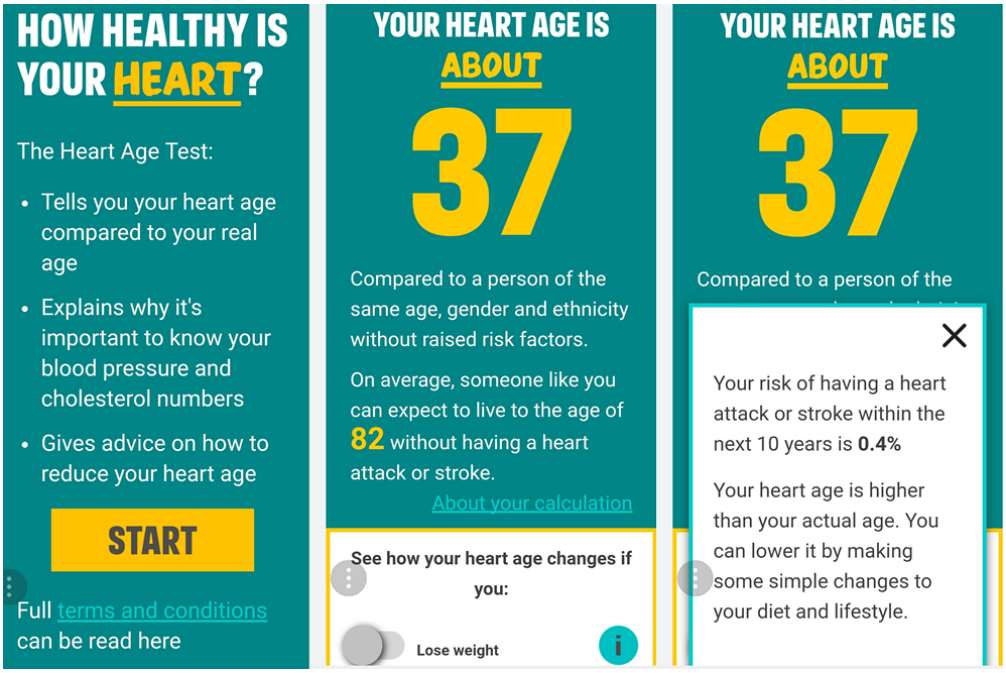

Heart Age Test results for a 35 year-old woman at low risk of CVD (Case 1,Table 1)